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NATIONAL OPEN UNIVERSITY OF NIGERIA University Village, Plot 91, Cadastral Zone, Nnamdi Azikwe Express Way, Jabi, Abuja FACULTY OF SCIENCES DEPARTMENT OF MATHEMATICS 2022_2 Examinations

Course Code: MTH305 Course Title: Complex Analysis II Credit Unit: 3 Time Allowed: 3 Hours Total: 70 Marks Instruction: Answer Question One (1) and Any Other 3 Questions

Q1 (a) (i) Define a single-valued complex function w(z). (3 marks)

(ii) If $z \in C$ such that z = x + iy and w(x, y) = u(x, y) = u(x, y) + iv(x, y) Suppose $f(z) = z^2$, find u(x, y) and v(x, y), (4 marks)

(3 marks)

- (b) Define each of the following:
- (i) a continuous function f at a point z_0 . (3 marks)
- (ii) a branch point.
- (c) (i) Show that the function $u(x, y) = y^3 3x^2y$ is harmonic. (4 marks)

(ii) Determine the poles and the residues at the poles of $f(z) = \frac{2z+1}{(z+1)(z-2)}$. (5 marks)

- (d) State the Green's theorem in a plane.(3 marks)Q2 (a) Define a transformation.(7 marks)
 - (b) Given that z is a complex number and w = f(z). Find $\frac{1}{z}$. (8 marks)
- Q3 (a) Define the limit of a complex function f(z). (5 marks)
 - (b) Suppose $z \in C$. Show that $sin^2z + cos^2z = 1$. (10 marks)
- Q4 (a) Define each of the following:
 - (i) removable singularities (3 marks)

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(ii) bounded complex function.	(4 marks)
(b) Prove that if $f(z) = \frac{\sin z}{z}$ then $z = 0$ is a removable singularity.	(8 marks)
Q5 (a) State the residue theorem.	(5 marks)
(b) Expand $f(z) = \frac{1}{z-3}$ in a Laurent series valid for $ z > 3$.	(10 marks)
Q6 (a) Define an analytic function $f(z)$.	(5 marks)

(b) Establish that the real and imaginary part of the function $f(z) = z^2 + 5iz + 3 - i$ satisfy the Cauchy Riemann equation and deduce the analyticity of the function. (10 marks)

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